

When Science Finds a Way

Trust in Science Miniseries, Episode 2

What does it take for science to be trustworthy?

Show notes

Episode description:

When we say we trust science, what are we actually trusting it to do? And who gets a say in where it goes next?

In the second episode of our special mini-series on trust in science, Alisha Wainwright is joined by bioethicist Dr Sarah Chan of the Usher Institute, University of Edinburgh, Professor Tom Ellis, co-director of the Imperial College Centre for Synthetic Biology, and Sarah Hartley, Professor of Technology Governance at the University of Exeter.

Our guests explore what makes science trustworthy, and why trust is rarely just about how much people know. Drawing on examples from synthetic biology and other areas of emerging science, they consider how new technologies can be developed responsibly, and how trust is shaped by whether decisions are made fairly, whether people feel listened to, and whether science is working on the problems that matter in their lives.

Along the way, the panel turns a familiar question around. Instead of asking whether the public understands science, they ask: does science understand its publics?

Mentioned in this episode & further resources:

- Wellcome Global Monitor: To access the report, interactive data dashboards, and the full data set, go to: wellcome.org/podcast/globalmonitor
- Earning public trust in science: To learn more about the work that Wellcome is doing on trust, go to: <https://wellcome.org/engagement-and-advocacy/engaging-people/trust-in-science>
- SynHG and Care-full Synthesis: To learn more about the Wellcome-funded project developing the tools for human genome synthesis, and the social research running alongside it, go to: <https://wellcome.org/news/new-project-pioneer-principles-human-genome-synthesis>
- Sciencewise: <https://sciencewise.org.uk>
- Nuffield Council on Bioethics, stem cell-based embryo models: <https://www.nuffieldbioethics.org/publications/stem-cell-based-embryo-models>
- Genetic Technology (Precision Breeding) Act 2023: <https://www.legislation.gov.uk/ukpga/2023/6>

Transcript

Music starts 00:00

[00:00:00] **Alisha:** Welcome to When Science Finds a Way, a podcast about the science changing the world. Today, we're asking what it takes for science to be trustworthy, especially when the science is fast-moving, complex, and potentially controversial. We'll use synthetic biology as our example because it raises difficult questions about risk, public value, regulation, and who gets a say.

We'll be putting all these questions to our interdisciplinary panel, so let's introduce them now. Sarah Chan is Chancellor's Fellow and Reader in Bioethics at Usher Institute, University of Edinburgh. Sarah's research focuses on the ethics of new biomedical technologies, topics like stem cells, embryo research, synthetic biology, and reproductive medicine.

Hi, Sarah.

[00:01:01] **Sarah Chan:** Hi, Alisha.

[00:01:03] **Alisha:** Tom Ellis is professor of synthetic genome engineering at Imperial College London and co-director of the Center of Synthetic Biology. He has also advised the UK government on the field. Welcome, Tom.

[00:01:16] **Tom Ellis:** Hello, Alisha.

[00:01:17] **Alisha:** And Sarah Hartley, a professor of technological governance at the University of Exeter and director of the Center of Responsible Innovation.

She has experience in the field of synthetic biology, specializing in governance of emerging biotechnologies, stakeholder engagement, and knowledge co-production. Thanks for joining us, Sarah.

[00:01:37] **Sarah Hartley:** Hi, Alisha.

[00:01:39] **Alisha:** There's a lot of discussion about trust in science at the moment. For example, as we discussed in the last episode, Wellcome has just published the Wellcome Global Monitor, the world's largest study of public trust in science and attitudes to health.

Can I start by asking each of you for some quick thoughts on why public trust is a key issue for science? Let's start with Tom.

[00:02:01] **Tom Ellis:** Well, I mean, first and foremost, I should say that the public fund a lot of the science and the investment in science, and they vote for what kind of government they would like and what they want the government to spend the money on.

And so it's key for science and science research that we're spending the public's money in the ways that they want to see it spent, in ways that will generate growth but also change the way the country is in each country for the better. So I think that's certainly why the public should care about science and why scientists should care about the public.

[00:02:39] **Alisha:** It's the people's science, so they should be able to trust it. That's a great answer. Sarah Chan, how about you?

[00:02:45] **Sarah Chan:** Science is an essentially public activity. If there is a moral justification for science at all, it must be that science achieves good for the public benefit. So if the justification for science is that it is for the public good, it's essential for us to be able to decide what the public good is in terms of the public being able to trust science, to understand what it's doing, and to have a say in the way that science is going.

[00:03:11] **Alisha:** Absolutely. Sarah Hartley?

[00:03:14] **Sarah Hartley:** Well, I agree with both of those points. One, that it's democratic, if you like, a democratic right of publics to have a say in, to be able to trust public science, but also, as Sarah said, that it can produce better science.

But I also worry a bit because often trust is correlated to support for science, so often it has an instrumental motivation to get trust in science so that people will support the science without really being engaged in it.

So I just yeah, I wanna put that out there as a potential challenge for trust.

[00:03:49] **Alisha:** Okay. Well, synthetic biology is a useful case study because it raises many of the questions at the heart of trust in science. Risk, regulation, public value, and who gets to shape decisions about emerging technologies.

Tom, you've worked in this field for decades. Can you give us a quick explanation of what this field is and what you see as some of the most exciting areas of potential?

[00:04:14] **Tom Ellis:** Sure. synthetic biology is kind of a bit of a broader term to kind of encompass really all sorts of ways that we manipulate and sometimes even research biology by changing the DNA code, and modifying that in ways that will get us new applications or new understanding of life.

It emerged 20 years ago as a subject thinking about how we engineer biology to help us make better biotechnologies and have a better kind of more sustainable way of making things. In terms of the areas with the most exciting potential, well, sustainability is definitely one. If you think about all the things we do with our lives and things we rely on, clothes we wear, houses we live in, how we heat our homes, and what we eat, so much of it is just stuff we're raiding from biology, from nature, right?

Particularly deforestation for wood and land for cattle, for example. So synthetic biology offers a way to instead achieve the sort of things we currently get from biology just by kind of plundering nature to instead find ways to make them in a more sustainable fashion, right? So that will really help us in a lot of our sustainability goals if we can understand how to harness biology in more sustainable ways.

[00:05:37] **Alisha:** Okay.

[00:05:38] **Tom Ellis:** To give you some examples of the kind of emerging innovations in these areas I'm talking to, right? At the moment there's increasing, consideration of alternatives to leather, one of which being is from filamentous fungi, and because they form this nice structure underneath the ground, and you can kind of harvest that structure, and it can really start to have a lot of the properties of, of a material that you would wear on a handbag or a shoe for a long period of time.

So they call this, myco-leather. But there's still a lot of problems in the production of it and getting the right consistencies, for the material properties you would want for leather, and that's really where genetic engineering and synthetic biology can come in. If we can reprogram those organisms so that, for example, they grow with a different kind of hydrophobicity or they have different flexibility, then that really helps in the process of getting these, these leathers. I mean, that sounds like quite a frivolous thing to do, but we need to remember that materials like leather come with a humongous climate impact. They're harvested from cows, and cattle ranching is the number one cause of deforestation in the world, as well as producing huge amounts of greenhouse gases.

So if we can use synthetic biology to really help drive sustainable alternatives to materials like leather or materials used in the construction industry, then we can have a huge impact in terms of carbon reduction on the planet.

[00:07:02] **Alisha:** Tom, what are some of the risks here that people who work in synthetic biology and regulators need to be attentive to?

[00:07:10] **Tom Ellis:** Yeah, I think the majority of synthetic biology research and applications underway at the moment are inherently really low risk.

There's very little going on that I know that is of significant risk and, for example gene editing in the human embryo, the human germline.

I think possibly the biggest risk in the research is, it's developing all these new technologies and these new capabilities to write DNA, to specifically get cells, in most cases harmless microbes like E. Coli or bacillus, to make things for us. But actually, the smallest genomes are viruses. So I think there is a risk there that by developing a technology that allows us to direct DNA to do very specific things and, be able to completely write the genome of bacteria, you are opening the door for, people to start doing the same with viruses, which will have a risk, because of just the threat viruses have.

So I think that's somewhere where there's a lot of attention being put in the past, and currently, for kind of biosecurity.

[00:08:31] **Alisha:** Can I ask Sarah Chan, what are some of the public concerns that might arise in areas of innovative bioscience like synthetic biology?

[00:08:40] **Sarah Chan:** I think the term synthetic biology itself is interesting because it sets up this potential distinction perhaps between what's synthetic, what's natural, what's engineered, what has come about.

And so I think there's a suite of concerns that may be attached to do, we fully understand what we're doing? There's a little bit in there of, perhaps fear of the unknown, and of course none of these are insurmountable concerns. One of the responses to fear of the unknown is, well, the more we know, the more we understand, the better we know how to do it.

But I think there are some concerns around the level to which we do fully understand, for example, the human genome. Do we fully understand the consequences of changing the genome? I think there's another set of concerns that relate to how we treat and how we value life and human life. So if we start treating human life or human beings as something to be engineered, are we starting to instrumentalize humans?

Are we beginning to treat them like machines? I'll bring in another term. So you mentioned gene editing or genome editing, and one of the, one of the terms that has often been used in a cautionary way around human genome editing, especially in a reproductive sense, is are we creating designer babies?

And once again, I, p- I personally particularly dislike this term. It is quite pejorative, but if you think about it, what else is designer? We have designer shoes and designer handbags, so the connotation, if you like, of designer babies is are we starting to treat our children like, like

luxury goods rather than ends in themselves. So I think there's some concerns around, is being able to engineer or to interfere with human life going to change the way that we value, the way that we value people, and the way that we value living things. And then I think there's a final – well, there are other concerns, but the other set of concerns I want to group together and think about are the concerns that are not actually about science, but about society and the way that society's organized.

So when people are worried, for example, about who's going to control this technology, is it going to be, commercialized and used for profit? Is it going to be owned by faceless multinationals? When people worry about genetic technologies being used to, say, engineer super soldiers under government control rather than to help people to have healthy children, these are actually all concerns not about the science, but about the social structures within which the science is coming into being and what that might mean for how the science is used.

[00:11:23] **Alisha:** What do you think, Sarah Hartley?

[00:11:25] **Sarah Hartley:** Well, I just, actually wanted to just come back to this issue of terminology because, the work we've done with public and stakeholder groups, it throws a challenge for public trust, because we've changed these names frequently, from genetic modification, genome, genetic engineering, biology, synthetic biology, genome editing. And when you go to talk to publics and stakeholders, for them, they're all the same thing. They're a form of genetic technology, which I think Tom was alluding to earlier, right? There's this kind of overarching sense of genetic technologies, but when we have these different names for them, and sometimes we see scientists and organizations within the sort of science milieu talking, about the distinctions between these as though they really matter, and that publics need to understand the differences between these terms in order to understand the science.

And I think for public trust, we need to think about how publics want to, how they want to talk about this in their own language. We don't need to make the difference between engineering biology or synthetic biology or genetic technologies or genome editing. For them, they're similar sets of concerns, and they should be able to talk about those technologies in their own terms.

Trust is about process and procedure, so we know that most people don't really care about science. They're not really interested in knowing all the things that we want them to know about science. They don't have time for it. They have other things that they're preoccupied with. Most people are interested in trusting the process of science, so what we call procedural legitimacy.

Is the process of making decisions legitimate? People trust the process, they're more likely to trust the outcome of that process. So it's not just about communicating the science to people. We just need to, also, help people understand or let people find out for themselves how decisions are made in science so that they can trust that system.

[00:13:27] **Alisha:** Ah, I think that's a really good point, procedural trust, because you don't have to necessarily understand the nuance of what's going on, but know that how it's being done is being done well and above board and with- ethical values that everyone could collectively agree is a good thing, What can science do to earn public trust in innovative fields like synthetic biology?

[00:13:52] **Sarah Hartley:** So I think it's really important to stress that science isn't just about the scientists doing the science, right? There are funders, there are government departments and agencies who set research agendas more broadly, who set policy. There are steering groups set up for synthetic biology and for other genetic technology areas who are expert advisory groups.

There are the regulators, and then there are scientific advisory bodies working within the regulatory environment. and then there are universities and other higher education institutions. So trust is often seen as, one of the ways to build trust is to communicate better to publics, and I think this needs to be challenged. So for me, public trust is about better listening. How can science listen better to publics and stakeholders? So communication isn't this one-way tool, that is at the use of science more broadly in telling publics how it's trustworthy, why publics should trust it, but actually to start to listen around what are the public concerns, what are the public desires for science?

Not just what the concerns about what do publics want from science. We do know that most publics want problems to be solved, that they're more likely to support science that solves problems than delivers economic growth, for example. That's a challenge for governments, but we need to address those challenges head on if we're gonna deal with public trust.

So certainly better listening, and seeing trust in science as an interdisciplinary endeavor. When we think about trust in science, we often think about science in labs, but there are social scientists working on this area, as well, and so thinking about science in this much broader kind of interdisciplinary context as well.

[00:15:38] **Alisha:** Okay, so thinking about how scientists communicate with the public, a lot of science communication has been based on this deficit model, right? It attributes public skepticism to the lack of understanding or a deficit of knowledge about science. But I know this approach has been heavily criticized.

So Sarah Chan, what are your thoughts here, and is there a better way for thinking about science communication?

[00:16:06] **Sarah Chan:** So the way that we think about the relationship between science and publics has evolved. Early on we had the idea of public understanding of science, and perhaps that's where what you've referred to as the deficit model came about, where perhaps we had the idea that, well, if the public only understood what science was doing, they would trust us, they would be supportive. And then we've moved from that to a more, two-way, or as I like to call it, multivalent way of thinking about it, which is not just public communication or public understanding, but public engagement.

And that implies not just telling publics, but engagement is, again, there's a back and forth there. It's not just a once-off, but it is a process, it's relational, it's dynamic, it's ongoing. So I suppose moving from the question about do publics understand science to ask, does science understand its publics?

And I think that's perhaps the biggest shift that we are seeing in how we think about that relationship and the side that most needs to be emphasized. With colleagues at Edinburgh, we've thought about the philosophy of public engagement, if you like, and these aspects of it being relational, ongoing, multiple, avenues of communication, listening as well as, telling.

All of those are very important.

[00:17:39] **Sarah Hartley:** And I think publics have much more to offer science in terms of actually helping us solve problems. And I think we can break down the public. It's often made up of people who are very smart or have a lot of knowledge about a certain area that we, within the scientific community, aren't aware of or could benefit from knowing, particularly knowledge around the problems that we're trying to solve.

And we've got numerous examples of technologies that have, that have not done what we intended, or who have failed because we haven't had this kind of engagement. This kind of engagement might be knowledge co-production – is a kind of, is one of the terms that we use for this way of co-producing technologies with different kinds of knowledge.

So I think we just need to, start to recognize the diversity of publics, and that there are, for example, if you're developing, or genome editing an invasive species to try and stop the invasive species, there are people who've worked with invasive species management for decades who we can bring in so we can start to understand how we currently manage invasive species, what the alternatives are, how a new emerging technology might fit with those alternatives.

And so bringing that knowledge in and thinking about how we co-produce technologies, I think is a really useful way to think about building trust, but also to think about doing better science rather than seeing the public as just a gate of yes or no.

[00:19:02] **Tom Ellis:** So that's kind of ... You're talking there more like stakeholder engagement rather than necessarily, talking to a journalist and seeing what happens when it goes on a newspaper.

[00:19:11] **Sarah Hartley:** That's right.

[00:19:12] **Alisha:** Sarah Chan?

[00:19:13] **Sarah Chan:** I won't go into examples, but what that highlights for me and what's the desired outcome when we engage with publics? What are we trying to achieve? And this is what I mean a little bit by the philosophy of engagements. What are we trying to do? How do we know when we're doing it well?

How do we know when we're doing it poorly? Among those who've, theorized public engagement, there are different justifications for why to do it, and one is fairly instrumental. It's that, publics are more supportive of science when they feel they've had a say about it and they've had a say in shaping it.

One is what we, bioethicists might call deontological, and that goes a little bit back to the justifications we were exploring at the start about, science is a public activity, therefore it is right to involve the publics. that ties in also with the democratic justification. But then there's also the idea, and Sarah you brought this up, that it actually makes for better science because it allows us to tap into different forms of knowledge, sources of knowledge that we may not have realized.

I think a really good example of this is, things like crowdsourcing health data and patient-generated data, via the internet. And if we can find a way to tap usefully into that, then we

have at our disposal so much more knowledge than just scientists in labs alone can generate. And so I think what we're seeing or what we're looking forward to in the future is maybe almost a, a sort of transformation of the epistemic hierarchy, if you like, where scientists have the knowledge and publics receive and benefit from the knowledge to a more, I suppose a more even view of how knowledge is generated and how knowledge is distributed.

There's specialized scientific knowledge generated with specialized methods, but there are also different forms of knowledge that publics can have and that we should be making use of and respecting.

[00:21:22] **Alisha:** I think one of the main pillars we're always trying to advocate for on this podcast is how beneficial it is to inject lived experience into science because time and time again, the science can be improved from someone on the receiving end of this knowledge, of this research.

And so I think to everyone's point, that is a good thing. I agree with that. It is the right thing to do. People should know where their money is going and what it's being used for, and it should, to their benefit, it should be communicated in a way that is not sensational and easy for them to at least delve into should they want to. So there's a lot of people across the spectrum of public, and everyone is entitled to as much information as is right and correct. What do you guys think about that?

[00:22:14] **Sarah Hartley:** I think this challenge is what Sarah Chan was talking about earlier about this, when she discussed the knowledge deficit, when she answered your question about the knowledge deficit model.

I think we're still in the scenario you've just painted, we're still seeing publics as a kind of vat for information, rather than people who can actually contribute to the development of the science. We need to shift that mindset around what roles publics have and what kind of knowledge they have.

People have really valuable knowledge that can contribute to the development of science, and we can engage with that knowledge. For some, that is the lived experience, but for others it's actually a knowledge that is important around the problem that you're trying to solve. So it's not just the lived experience, but there are lots of other different types of knowledge.

So disaggregating the idea of knowledge, as this kind of hierarchy, as Sarah Chan was saying, there's this sort of hierarchy of knowledge at the moment, and we see two types. We see scientific knowledge, and then we see publics as the kind of receptacle for that knowledge. But we need to really flip that around and start to see what, what kind of knowledge do we need to make better science?

Who has that knowledge? And then how can we engage that knowledge so that it has some impact, some valuable impact on the science that we're developing.

[00:23:31] **Alisha:** Tom, do you have any thoughts on practical ways to integrate public trust into scientific research?

[00:23:37] **Tom Ellis:** It's difficult because, again, like we said, public is not really one thing, right?

There's a variety of different stakeholders, and you want to engage by doing things like press releases, talking about your work at events, public events, right? You want to engage with as many people as possible. So engagement as a scientist takes up some time and resources, and I broadly think that there's kind of two types of general engagement.

One is just kind of posting about your stuff on LinkedIn, X, wherever, and that really doesn't take much effort, But I think that there's no real barrier for that kind of engagement. More thought out and careful engagement, that is a real a lot of effort, right? You often have to put significant resources, get a lot of materials together.

It can be very valuable, but it's definitely something that takes up a lot of your time. Fortunately, now some funders and institutes, and particularly my university, they can often allocate funds and time, and even if it's something high profile, they can help second someone to work with you for a while to generate the materials you need for this kind of thing.

[00:24:45] **Alisha:** Absolutely.

[00:24:46] **Tom Ellis:** So there's a synthetic genomics program that's kicking off that I am part of, which is called SynHG. So SynHG is an acronym for synthetic human genome. It's a big research project that actually isn't intent on producing a whole synthetic human genome, but is about developing the methodologies that would underpin making regions of the human genome synthetic.

Yeah, one exciting thing about SynHG is it includes this extra work package, called Care-Full Synthesis, which is kind of... it's there to work with the main project, but it, in many ways it's independent, and it's supposed to not necessarily be too involved in the project. And that's to think about the ethics and the implications of the work of making synthetic human chromosomes and regions of human chromosomes.

We can obviously think of lots of the benefits that such work could unlock, but there's many people out there who will hear about this work and only think about potential downsides to it. And so we need to think about that and have an audience with the people who have those doubts and, and through a process of dialogue kind of map out what people's feelings are about this kind of work, not just in the UK, not just in the communities of scientists, but, thinking really broadly all around the world, what would this kind of technology, if it works and it unlocks things, what does it mean to people and what are people's fears and hopes for it? You want to engage with as many people as possible, and the really beneficial ones is when you meet the sort of stakeholders that Sarah is talking about, that really can tell you something important about the research you're doing, the directions you're taking, that can then be instrumental in you making the correct decisions to take it further, or getting the data, getting the know-how to unlock something much more than what you're doing.

[00:26:41] **Sarah Hartley:** I should also just mention that we have done lots of public engagement in synthetic biology in the UK. We've had numerous dialogues and public engagement exercises held by different organizations, with... There's one going on right now, led by, Department of Science Innovation Technology in collaboration with Science Wise, and I'm actually chairing the oversight group for that dialogue.

So I think we do often know what publics think, the broader kind of representative publics, that is. I think the challenge for engagement, one of the other challenges for engagement is, what we do with that information once we have it. So we do these dialogues, we have a report that comes out, we know what publics think, and then it kinda stops there.

So we, in the social science world, we're looking at well, what, can you do with that then? What decisions can that information from those dialogues shape? How can we use those dialogues in ways that improve the quality of the science and the process, through which we develop that science?

So I think that's something for, not for the scientists in the lab necessarily, but for the broader kind of institution of science that we see in the UK.

[00:27:47] **Alisha:** Well, I think we've touched on this already, but thinking about regulation and governance of science research, who should be involved here, and is there a role for the public?

So I'll start with Sarah Hartley.

[00:28:03] **Sarah Hartley:** So yes, so first of all, yes, there's definitely a role for the public in this, in the governance of science and technology, and particularly for synthetic biology. And we have a long history of that in the UK with synthetic biology, of bringing different groups in, whether that's, through the kind of public dialogues that you've just mentioned, Or whether that's, through stakeholder engagement with scientific, with scientific groups.

And we've had the engineering biology centers that have also have some interdisciplinary engagement as well. But I think we could certainly be doing more in that space. Regulation, for example, is still seen to be a very technical space where public engagement is very challenging. So where we see spaces of public engagement are in broad policy areas.

But when we get to the technical side, particularly around regulation, there is... it's very difficult to do public engagement there because publics aren't seen to have the adequate, technical know-how to engage. Although the research we're doing shows that it is possible to do engagement in regulation.

[00:29:12] **Sarah Chan:** I think engagement in regulation, yes, I absolutely agree there is definitely a role for publics, and it doesn't have to be in working out the technicalities of regulation. I agree there is often actually more there than we may give credit for. But in the same way as engagement with science doesn't mean asking publics precisely how to do an experiment, but instead finding out what do publics want from science, what are their, worries, what are their hopes, I think engagement with regulation should fundamentally be about finding out what matters. And then it can be down to the drafters of legislation, et cetera, to work out how exactly that gets implemented. But you know what's important? What do we really want to happen? What do we really want not to happen?

We did a bit of this in the Nuffield Council on Bioethics in the work on what's been called stem cell-based embryo models to bring in yet another area of technology, that this is an area that potentially has a lot of existing regulation around it in the UK. We don't necessarily expect publics to know all of the ins and outs of the legislation, but we do want to know, well, what, what matters to people?

What kinds of desirable futures do we want to bring about? What sorts of undesirable futures do we want to avoid?

[00:30:36] **Sarah Hartley:** I should, also just... if I can add to that, in the plants' biotechnology space, we have the new genome, the new Precision Breeding Act and the regulations that came into force last year from the act.

And when we look at, well, the research we've done is looking at how what kind of knowledge, what other kinds of knowledge could shape risk decision-making around these technologies. And it's interesting because some of the kind of core concepts of risk like, efficacy. So efficacy is a way of measuring technology or the risk of a technology by saying, "does it work? Is it efficacious? Does it work in the way we intended it to work?" What we've found is stakeholders and publics have quite a different interpretation of efficacy. For them, it's like, does the problem get solved? So not just does it work technically, but does the problem get solved by this technology?

So I think we could do much more work on the regulatory side around understanding how publics view regulation and risk assessment in particular, because I think that is a potential way that trust could be improved, is by better understanding of how publics perceive risk within the regulatory context.

And one of the things we know on the plant side is that, labeling is really key for trust. Publics want genome-edited food labeled. That's come up time and time again in public engagement exercises. Yet it's not required. It won't be required in the UK for genome-edited crops or plants.

And so because I think it would potentially stigmatize these crops, whereas publics still want to know what they're eating. And so there is a tension sometimes between what we think is right in terms of the technical side, but what publics actually want and how they perceive risk on the other side.

[00:32:26] **Alisha:** So looking to the future, how do we think the idea of trustworthiness will shape the field of synthetic biology going forward?

[00:32:36] **Tom Ellis:** So I'll jump in. The field going forward is going to be very heavily influenced by AI, and that is because the field is about writing DNA, and DNA is kind of a complex language that we're only learning as we do the research of, changing the DNA and seeing, seeing what it does inside cells.

And obviously, as we know, right, AI is all about language models, and it's very good at being able to turn information in from language and understand it and design it. So I think the risk coming, or the way we need to think about things coming is, what happens when we're now working with biology to make biotechnologies to try to improve things for people, but now it's AI making a lot of the decisions.

Because biological systems are complicated, it's perhaps easier to think of AI doing a lot of the design and proposing the testing than teams of human experts, which are hard to get to work together sometimes. And so I think there's a risk area coming there that what happens, and I think this is something we'll see with a lot of things with AI, is like what happens when we just don't know what the AI is doing?

[00:34:01] **Alisha:** Good point.

[00:34:02] **Sarah Chan:** But this idea that publics, that stakeholders, that patients can actually produce valuable knowledge and that we should be looking at that, I think is a, that's a really powerful idea that we need to keep hold of.

[00:34:13] **Sarah Hartley:** But I wanted to come in on a separate point, which is something I think to think about in the future as we move forward, and this is a challenge certainly that we've seen in engineering biology, synthetic biology, et cetera, in the, genetic technologies, is this tension between economic and public value, and it's a dominant theme in public engagement exercises in this space.

It comes up time and time again as one of the major concerns of the public, and it's really related to public trust in that publics don't trust science if it's purely for economic gain. They want public value delivered from science. And I think this is a huge challenge because governments all over the world rely on science and technology as a cornerstone of economic growth.

And so there is a need to develop science and technology, invest in science and technology, so that it can deliver the kind of economic value, that is, for example, jobs, startups, eventually, products, taxation, et cetera, feeds into the economic system. Whereas publics want problems solved, they want cancer solved. They want food that's affordable. They want less agricultural inputs, chemical inputs in the soil. So publics see a public value from science being in solving these problems. and there is a tension then between, well, what do we do with science, because we need to commercialize it in order for it to address some of this, deliver the public value.

So we can, for example, think about how we might change the metrics of measuring economic value, perhaps to have a broader kind of, a broader measure of what economic value, economic and social value is. Often economic and social value is measured in very narrow terms, and how we measure public value.

And so I think moving forward, not just in this space of synthetic biology, but more broadly in science of technology, we need to think about how we balance that economic value and public value from science.

[00:36:23] **Alisha:** So I'd like to finish our conversation by asking you to make one headline insight you'd like our listeners to take away from this podcast episode.

[00:36:33] **Tom Ellis:** It's important in science to understand the stakeholders, and I think the key thing to learn about public engagement is that the best thing that can come out of it is stakeholder discovery. It's not about getting the good headline that the guy at the Daily Telegraph or whatever chooses and gets you a fun headline.

[00:36:58] **Alisha:** Sarah Hartley?

[00:36:59] **Sarah Hartley:** So the tagline for me I think would have to be something like, building public trust isn't to gain public support, but to do better science. And I think that's really fundamental for me. The things we've been talking about, whether that's stakeholder engagement or public engagement or knowledge co-production, these kinds of better

listening than talking, is all around trying to do better science rather than just trying to get public support for science that's being determined by others.

So it's really about bringing different publics in different ways to do that better.

[00:37:30] **Sarah Chan:** Okay. So I'm going to bring up something here that maybe we haven't talked enough about, because we've talked about trust as if it's a sort of a unitary general thing. Because I might, for example, trust my 10-year-old niece to wake me up in the morning, but I wouldn't trust her to drive my car.

So what are we trusting science, or what are we, what do we want publics to be able to trust science to do? And that question about trust for what, trust in what, I think is something that we need to reflect more on. I think it comes down for me to perhaps, Sarah, going back to the idea of procedural legitimacy, trust in the process.

Trust that perhaps scientists share the same values that we do, the same sort of vision for society. But yeah, that idea of trust that ... I suppose it's trust in things like the medical profession, trust in your doctors. The question that I most often want to ask my doctor is, "Well, if it were you, what would you do?"

So that sort of notion of shared values, shared humanness, shared vision for a better future. We want to know that scientists share that with us, and that they want to bring it about as much as we do.

[00:38:50] **Alisha:** Leave it to the bioethicist to take the question and make it a very holistic understanding of, "what is trust? What is science?" I just want someone to treat me well and have simple, shared principles and values that we can all align on. I think that's actually an incredible place to end our conversation. Thank you, everybody, for coming from all corners of our planet to have this very delightful conversation.

In our next episode, I'm passing the mic to Julia Gillard, chair of Wellcome, as she explores how power, politics, and participation shape trust in science. It's set to be a fascinating discussion, so be sure to tune in.

Thanks for listening to this episode of When Science Finds A Way, and thanks to our panel, Sarah Chan, Tom Ellis, and Sarah Hartley. If you enjoyed this episode, make sure to follow us wherever you get your podcasts, and like and subscribe on YouTube.

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